

**X-treme EEG - Studying the Neurophysiology of Motor Control in Extreme Conditions:
space, deep water and during maximal exercise**

Stefan Schneider

Institute for Movement and Neurosciences, German Sport University Cologne

Assessing brain cortical activity while being exposed to extreme conditions has been a challenging task and only in the past few years first attempts have been successful. In my talk I will present three studies trying to assess the underlying neurophysiological processes of human motor control while being exposed to extreme conditions: (1) Space, (2) deep water and (3) maximal exercise. This talk aims not only introduce up-to date neurophysiological methods, but also encourage students to go beyond current scientific barriers.

(1) Although several previous studies have shown that motor control seems to be impaired while being in weightlessness, there is good reason to speculate that, from a neurophysiological point of view, the redistribution of blood volume leading to an increase in brain oxygenation during weightlessness, positively impacts neural processing.

(2) The neutral buoyancy facility at the European Astronaut Centre in Germany allows astronauts to prepare for extra vehicular activities by providing a 1:1 model of the international space agency (ISS). Although this allows a number of simulations, it is questioned whether the underwater atmosphere is a transferable equivalent for a space walk. In a pilot

study we assessed the neurophysiological response to a complex decision task. Results let us assume that central processing is not impaired in deep water.

(3) Whereas previous experiments trying to identify the neurophysiological correlates of motor control were limited to hand or finger movements in an fMRI scanner, electroencephalography in combination with electrotomography allows to identify central processes even during maximal exercise. We were able to show that the pedaling cycle during biking is represented by a specific oscillation pattern in the motor cortex, which keeps stable during different stages up to submaximal exercise intensity. This might be an important finding for future studies differentiating between central and peripheral fatigue.

To sum up, this talk is dedicated to demonstrate the ability to record motor control related brain cortical activity in extreme conditions. Although just the results of a number of pilot studies is presented, the ability to assess brain cortical function in extreme conditions will help us to further understand the underlying neurophysiological correlates of physical activity and allow to identify central nervous in previously inaccessible conditions.